Effective mycological markers of polluted soils

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Fungi play a crucial role in the processes of biomass and energy turnover in ecosystems. Technogenic transformation of the soil mycobiota structure can lead to the destruction of the regulatory mechanisms and the balance of biosynthesis and as well as to the biodegradation of organic matter on the Earth.

The systems of biotic parameters to assess the technological impacts on ecosystems traditionally include a set of common indices (abundance, biomass, diversity, etc.). These indices can be useful in site specific ecological risk assessment (ERA) based on Triad approach, in which chemical, toxicological and ecological data for a contaminated site are assessed (Chapman et al., 2002). The finding of mycological markers to evaluation of the environmental quality of soil ecosystems is relevant in this case.

Many authors include the classical synecological parameters of microscopic fungal communities, namely species indices of the taxonomic diversity (number of species, dominating forms, richness of species, Shannon, Pielu, diversity indices) in scheme of ecological soil control. But the effectiveness of estimation the environment quality using these markers depends on the kind of contamination (Terekhova, 2007).

During the past several decades it has been recognized that dark-colored melanin-containing species of micromycetes are being used as diagnostic instruments to determine the adverse environmental conditions, in particular under radioactive pollution (Zhdanova, Vasilevskay, 1988). Melanins increase resistance of fungi to radionuclides, heavy metals, and oil in soil. Indexes of melanin-containing forms of micromycetes are very effective in ecological evaluation in these cases.

According to our data, the number of dark colored species of micromycetes and melanin-containing mycelium in the total fungal biomass increased in three-fold in heavy polluted soil, in which the Saet index of heavy metal content (Zc) ranged from low to high level of pollution. Nevertheless this phenomenon is hardly observed at soil contamination by organic waste (Terekhova, 2011).

According to the "melanoid" concept the fungal melanin involved in synthesis of humic substances in soil (Kim, 2003; Khundzhua et al., 2013). The increasing the content of dark-pigmented micromycetes in adverse conditions under stress enriches of organic matrix in soil. On the other hand, it is known that many toxicants can reduce their damage to biota in humus-rich soil. On this basis we can assume that there is a regulatory mechanism to sustain the functioning of ecosystems, in which dark-pigmented fungi play an important role.

Thus, reliability indices of melanin containing forms as diagnostic instruments for the environmental assessment is probably explained by the special regulatory mechanism associated with fungal melanin in the synthesis of humic substances. The potential of this concept for assessing soil quality will be briefly presented.

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